Cobalt Geosciences, LLC
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October 17, 2023

Christopher Lee
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RE: Limited Geotechnical Evaluation
Proposed Foundation Mitigation
3619 81st Avenue SE
Mercer Island, Washington

In accordance with your authorization, Cobalt Geosciences, LLC has prepared this letter to discuss the results of our limited geotechnical evaluation at the above-referenced location.

Site and Project Description

The site is located at 3619 81st Avenue SE in Mercer Island, Washington. The site consists of one rectangular shaped parcel (No. 4457700110) with a total area of about 10,973 square feet.

The central portion of the site is developed with a residence with basement areas and driveway. The remainder of the property is vegetated with grasses, bushes, and trees. The site slopes downward from southeast to northwest and west at magnitudes of 0 to 20 percent and relief of about 14 feet. There are short timber and modular block walls near the residence and some property lines.

The site is bordered to the north south, and west by residential structures, and to the east by 81st Avenue SE.

The western portion of the site is mapped as an erosion and potential landslide hazard area. There are seismic hazards mapped east of the property.

We understand that portions of the residence have settled over time and that foundation mitigation is currently proposed. This work will likely include minor excavations near the structure to allow for pier installation. We have included general recommendations for pier placement, if this information is required.

Area Geology

The site lies within the Puget Lowland. The lowland is part of a regional north-south trending trough that extends from southwestern British Columbia to near Eugene, Oregon. North of Olympia, Washington, this lowland is glacially carved, with a depositional and erosional history including at least four separate glacial advances/retreats. The Puget Lowland is bounded to the west by the Olympic Mountains and to the east by the Cascade Range. The lowland is filled with glacial and non-glacial sediments consisting of interbedded gravel, sand, silt, till, and peat lenses.

The Geologic Map of Mercer Island, indicates that the site is near the contacts between Vashon Advance Outwash, Vashon Glacial Till, and Vashon Recessional Outwash.

The outwash includes fine to medium grained sands that become denser with depth and are mapped near the western margin of the site. Vashon Glacial Till includes dense to very dense mixtures of silt, sand, gravel, and clay in a nonsorted matrix. These deposits are common in upland planes and ridges. Vashon Recessional Outwash can include lacustrine silt and clay along with coarse sand and gravel. These deposits are normally consolidated and mapped east of the site.

Soil & Groundwater Conditions

As part of our evaluation, we excavated one hand boring to 4 feet below grade. The hand boring encountered approximately 6 inches of topsoil and vegetation underlain by approximately 1.5 feet of medium dense, silty-fine to fine grained sand trace gravel (Weathered Glacial Till). This layer was underlain by very stiff to hard, silt with sand and gravel (Glacial Till), which continued to the termination depth of the exploration.

Groundwater was not encountered in the hand boring. We reviewed numerous nearby explorations. The soils became dense to very dense at relatively shallow depths below a weathered zone and/or areas of fill. Light volumes of perched groundwater may develop below the site during the wet season.

Geologic Hazards

The site is mapped within a potential slide hazard area and erosion hazard area. The erosion hazard can be maintained at a low level with proper use of temporary erosion control measures. For this project, these should consist of placing all excavated soils onto plastic and covering these with plastic sheeting. Depending on the locations of the work, a silt fence may be required to be keyed into the surface materials downslope of excavations.

The potential slide hazard is likely due to the presence of mapped moderately steep slopes coupled with the mapped outwash sands, which can have some potential for both erosion and surface sliding. Based on our observations of the area topography and presence of dense till-like soils at shallow depths, it is our opinion that the risk of soil movements is very low at this time.

The proposed construction includes very small excavations near the foundation. It is our opinion that this work is very minor and will not affect any geologic hazards. Typically, this work takes a week or less to complete.

Statement of Risk

Per Section 19.07.160B3 of the Mercer Island City Code, development within geologic hazard areas require that a Geotechnical Engineer licensed within the State of Washington provide a statement of risk with supporting documentation indicating that one of the following conditions can be met:

a. The geologic hazard area will be modified, or the development has been designed so that the risk to the lot and adjacent property is eliminated or mitigated such that the site is determined to be safe; or

b. An evaluation of site specific subsurface conditions demonstrates that the proposed development is not located in a geologic hazard area; or

c. Development practices are proposed for the alteration that would render the development as safe as if it were not located in a geologic hazard area; or

d. The alteration is so minor as not to pose a threat to the public health, safety and welfare.

The project meets the criteria of c and d from above. The foundation mitigation work will result in the residence being safer than what is currently present, similar to areas not within the hazard zone. Additionally, the work is so minor that it does not pose a threat to health, safety and welfare.

Conclusions and Recommendation

Based on our observations, it appears likely that the settlement is likely the result of insufficient removal of loose weathered soils prior to foundation placement and not the result of larger scale land movements. There may be areas of fill below some foundation elements, that could contribute to the settlement. Roof runoff, if uncontrolled, could have contributed to the settlement over time.

The proposed mitigation work will not adversely affect erosion or landslide hazards provided temporary erosion control measures are installed during the work.

It is our opinion that earthwork and grading activities can take place during the wetter months of the year, typically October through March, provided adequate steps to prevent soil erosion and uncontrolled runoff are implemented prior to construction.

A silt fence should be installed downslope of any excavation locations and all soils should be placed on plastic and covered with plastic when work is not occurring. We can provide monitoring of erosion control measures upon request or if required.

Helical Piers®

Helical Piers® may be used to support the residence. The Helical Piers® could be installed using portable rotary tools, truck mounted rotary tools, backhoe mounted rotary tools, caisson drills, or skid-steer loaders. It is important that the torque output, rotational speed, down pressure capability, and angle control of the installation equipment is compatible with the required foundation system. The pile installation equipment should have adequate torque capacity to prevent refusal conditions at relatively shallower depths that are well above recommended bearing depths or layers.

A Helical Pier® consists of an anchor (lead section) with 1, 2, 3 or more helical flights on a shaft. The number and diameter of the helices on the anchor are dependent on the soil characteristics of the site and the design loads to be applied to the pier. Based on these parameters the anchor helix configuration is chosen to best fit the site conditions.

As the anchor is advanced into the soil extension sections (shaft) are placed on the lead section. The shaft configuration is based on the design loads and anticipated installation torque.

The static compression load capacity of a Helical Pier® is the sum of all individual helix capacities below liquefiable soils and in bearing layer. Individual helix static compression capacity is the result of the projected area of the helix, and its bearing pressure.

It is recommended that the piers penetrate into relatively dense native soils a minimum of 3 feet, or until refusal whichever is shallower. The bearing layer will be at variable depths below the existing ground surface due to previously natural slope conditions (anticipated to be 5 to 10 feet). Increased capacity can be obtained with increased penetration, and additional helical flights on the lead section.

Helical Pier® installation should be monitored to verify installation torque, and proper embedment into the presumed bearing layer. The Helical Pier® lengths may need to be modified during construction if it is determined that the depth to the bearing layer varies. Helical Pier® anchors are well suited to field adjustments as length can be varied by merely adding or deleting extension sections (shafts) during installation.

Monitoring installation torque in the field is used to estimate the anchor compression capacity, and also as a quality control during anchor installation, provided that the anchor is bearing in dense or hard soils. Dependent on the pile size and the equipment used to install the anchors, an empirical factor is multiplied by the average torque over the final 3 feet of installation to estimate ultimate capacity.

Allowable Helical Pier Compression Capacity Pa may be estimated from the following equation provided that the pier is in the recommended bearing soils:

Pa = Kt x T/FoS,

Where T is the applied torque, Kt is the empirical ratio factor. The following industry standards apply to shafts with blades spaced along the shaft at 2.5 to 3.5 times the average blade diameter on-center and meeting the manufacturer's specifications.

1.5" and 1.75" Square Shafts - Kt = 9 ft-1

2.875" O.D. Round Shafts - Kt = 9 ft-1

3.0" O.D. Round Shafts - Kt = 8 ft-1

3.5" O.D. Round Shafts - Kt = 7 ft-1

Proof testing of at least 3 percent of the helical piers in eight equal increments up to 200 percent of the design load, if required by the permitting authority. Each load increment up to the 200 percent of design load should be held for five (5) minutes and the vertical strain monitored. If the total strain between 1 and 5 minutes is less than 0.04 inches, the helical pier may be considered acceptable. If the recorded strain exceeds 0.04 inches, the helical pier should either be deepened and retested or abandoned and a new helical pier shall be installed and tested.

Closure

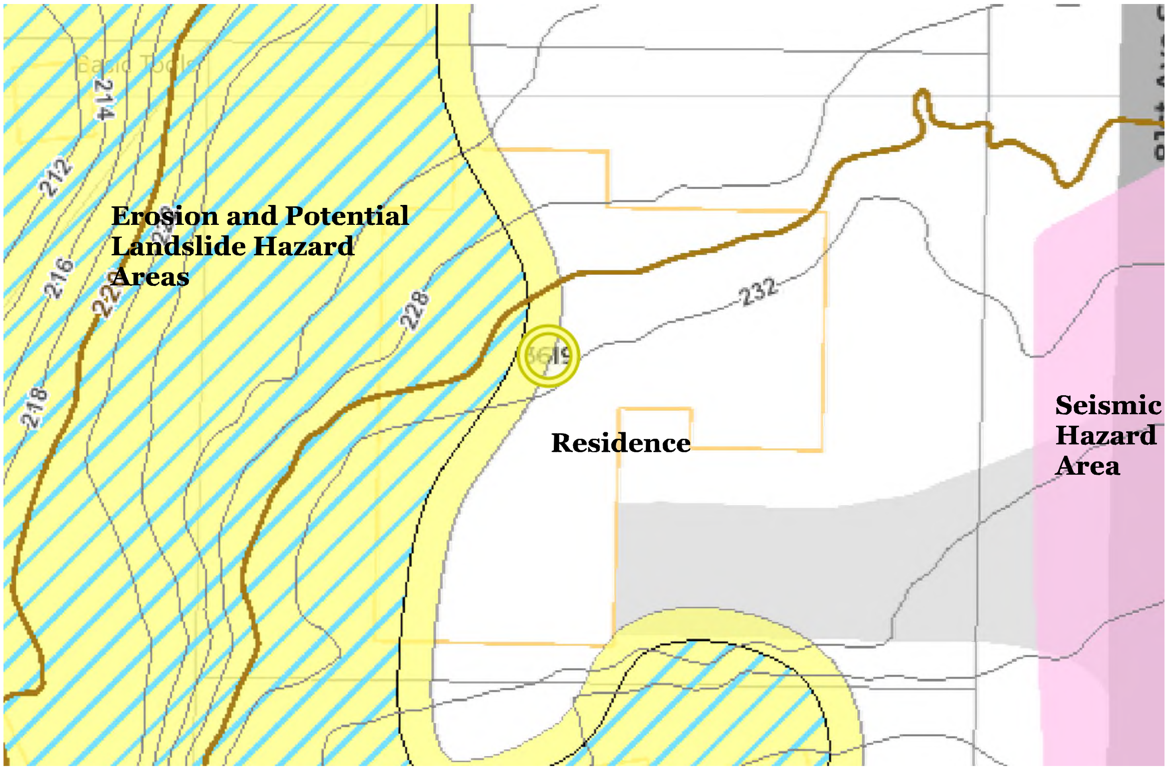
The information presented herein is based upon professional interpretation utilizing standard practices and a degree of conservatism deemed proper for this project. We emphasize that this report is valid for this project as outlined above and for the current site conditions and should not be used for any other site. Our scope of services do not include borings or slope stability analyses or potential affects of slope stability on the residence.

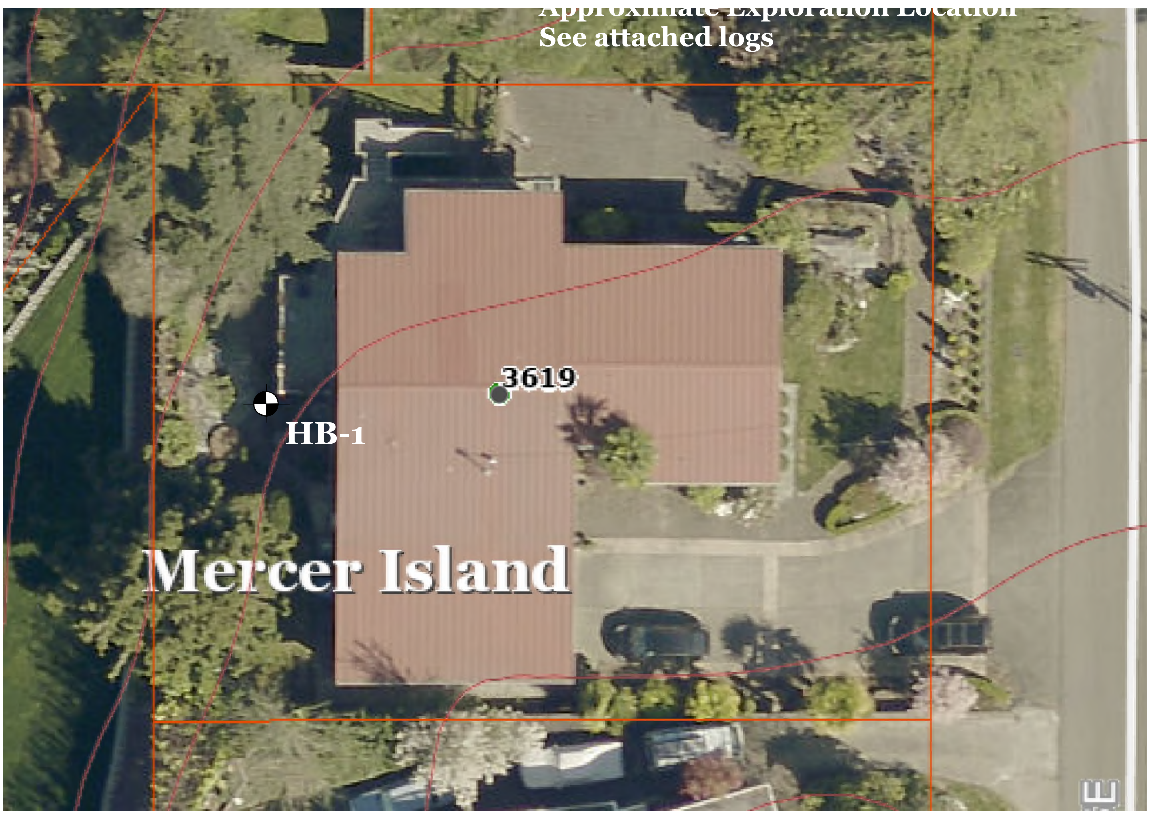
Sincerely,

Cobalt Geosciences, LLC

10/17/2023
Phil Haberman, PE, LG, LEG
Principal

Mercer Island GIS Map





HB-1 **Approximate Hand Boring Location**

N

King County Imap

Not to Scale

COBALT GEOSCIENCES	Proposed Foundation Mitigation 3619 81st Avenue SE Mercer Island, Washington	**SITE MAPS** **FIGURE 1**	Cobalt Geosciences, LLC P.O. Box 82243 Kenmore, WA 98028 (206) 331-1097 www.cobaltgeo.com cobaltgeo@gmail.com

Unified Soil Classification System (USCS)

MAJOR DIVISIONS			SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS (more than 50% retained on No. 200 sieve)	Gravels (more than 50% of coarse fraction retained on No. 4 sieve)	Clean Gravels (less than 5% fines)	GW	Well-graded gravels, gravels, gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
		Gravels with Fines (more than 12% fines)	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sands (50% or more of coarse fraction passes the No. 4 sieve)	Clean Sands (less than 5% fines)	SW	Well-graded sands, gravelly sands, little or no fines
			SP	Poorly graded sand, gravelly sands, little or no fines
		Sands with Fines (more than 12% fines)	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
FINE GRAINED SOILS (50% or more passes the No. 200 sieve)	Silts and Clays (liquid limit less than 50)	Inorganic	ML	Inorganic silts of low to medium plasticity, sandy silts, gravelly silts, or clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays silty clays, lean clays
		Organic	OL	Organic silts and organic silty clays of low plasticity
	Silts and Clays (liquid limit 50 or more)	Inorganic	MH	Inorganic silts, micaceous or diatomaceous fine sands or silty soils, elastic silt
			CH	Inorganic clays of medium to high plasticity, sandy fat clay, or gravelly fat clay
		Organic	OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT	Peat, humus, swamp soils with high organic content (ASTM D4427)

Classification of Soil Constituents

MAJOR constituents compose more than 50 percent, by weight, of the soil. Major constituents are capitalized (i.e., SAND).

Minor constituents compose 12 to 50 percent of the soil and precede the major constituents (i.e., silty SAND). Minor constituents preceded by "slightly" compose 5 to 12 percent of the soil (i.e., slightly silty SAND).

Trace constituents compose 0 to 5 percent of the soil (i.e., slightly silty SAND, trace gravel).

Relative Density (Coarse Grained Soils)

N, SPT, Blows/FT	Relative Density
0 - 4	Very loose
4 - 10	Loose
10 - 30	Medium dense
30 - 50	Dense
Over 50	Very dense

Consistency (Fine Grained Soils)

N, SPT, Blows/FT	Relative Consistency
Under 2	Very soft
2 - 4	Soft
4 - 8	Medium stiff
8 - 15	Stiff
15 - 30	Very stiff
Over 30	Hard

Grain Size Definitions

Description	Sieve Number and/or Size
Fines	<#200 (0.08 mm)
Sand	
-Fine	#200 to #40 (0.08 to 0.4 mm)
-Medium	#40 to #10 (0.4 to 2 mm)
-Coarse	#10 to #4 (2 to 5 mm)
Gravel	
-Fine	#4 to 3/4 inch (5 to 19 mm)
-Coarse	3/4 to 3 inches (19 to 76 mm)
Cobbles	3 to 12 inches (75 to 305 mm)
Boulders	>12 inches (305 mm)

Moisture Content Definitions

Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, from below water table

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Soil Classification Chart

Figure C1

Log of Hand Boring HB-1

Date: October 2023	Depth: 4'	Initial Groundwater: None
Contractor:	Elevation:	Sample Type: Grab
Method: Hand Auger	Logged By: PH Checked By: SC	Final Groundwater: N/A

Depth (Feet)	Interval	% Recovery	Blows/6"	Graphic Log	USCS Symbol	Material Description	Groundwater	Moisture Content (%) Plastic Limit – Liquid Limit; SPT N-Value 0 10 20 30 40 50
0						Vegetation/Topsoil		
1–2	■ (at 2)				SM	Medium dense, silty-fine to medium grained sand trace gravel, mottled yellowish brown, moist. (Weathered Glacial Till)		
2–4	■ (at 3.5)				ML	Very stiff to hard, silt with fine sand and gravel, grayish brown, moist. (Glacial Till)		
4						End of Hand Boring 4'		
5								
6								
7								
8								
9								
10								

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Hand Boring Log